Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

I Claim:

1. (Currently Amended) A method for multi-input multi-output (MIMO) channel estimation, the method comprising:

transmitting training sequence signals from a plurality of transmitting antennas, through said MIMO channel, such that training sequence signal transmissions from at least two of said plurality of transmitting antennas overlap in time;

said training sequence signals being sent in blocks and said blocks number as many or more than a number of said transmitting antennas, and (i) during one block all transmitted training sequence signals share a same phase and (ii) during another block all transmitted training sequence signals have a different phase;

receiving said training sequence signals at a plurality of receiving antennas, through said MIMO channel; and

comparing said transmitted training sequence signals with said received training sequence signals to generate an estimate of a characteristic of said MIMO channel.

2. (Original) The method of claim 1, wherein said estimate of a MIMO channel characteristic comprises a set of coefficients wherein, for each receiving antenna, at least one coefficient corresponds to each transmitting antenna.

3. (Currently Amended) The method of claim 1, wherein said transmissions from at least two of the plurality of transmitting antennas occur ~~substantially~~ simultaneously in time.

4. (Original) The method of claim 1, wherein said training sequence signals have equal power spectral density in frequency and time.

5. (Currently Amended) The method of claim 4, wherein said training sequence signals comprise ~~are~~ chirp signals.

6. (Currently Amended) The method of claim 4, wherein said training sequence signals are sent in blocks and each block is preceded by at least one cyclic prefix[[es]].

7. (Currently Amended) The method of claim [[5]]6, wherein said blocks number as many or more than said transmitting antennas and during one block all transmitted training sequence signals share a same phase.

8. (Currently Amended) ~~The method of claim 7, wherein~~ A method for multi-input multi-output (MIMO) channel estimation, the method comprising:

transmitting training sequence signals from a plurality of transmitting antennas, through said MIMO channel, such that training sequence signal transmissions from at least two of said plurality of transmitting antennas overlap in time;

receiving said training sequence signals at a plurality of receiving antennas, through said MIMO channel; and

comparing said transmitted training sequence signals with said received training sequence signals to generate an estimate of a characteristic of said MIMO channel; and

wherein said training sequence signals are sent in blocks and said blocks number as many or more than a number of said transmitting antennas;

during one block all transmitted training sequence signals share a same phase, and

during other blocks, all transmitted training sequence signals have a different phase.

9. (Currently Amended) The method of claim 8, wherein said estimate of said characteristic of said MIMO channel is generated, at least in part, by a transform based procedure.

10. (Currently Amended) The method of claim 8, wherein said blocks number N_{block} and said transmitting antennas number N_{TX} where N_{block} is greater than or equal to N_{TX}, and said blocks are numbered according to a block number t where t -> 0,..., N_{block}-1, and said transmitting antennas are numbered according to a transmitter antenna number m where m -> 1,... N_{TX}, and said transmitted training sequences, $x_m[t,k]$ are proportional to:

$$x_m[t,k] = \exp(2\pi jmt / N_{block}) \exp(\pi jk^2 / T_{chirp}) .$$

where integer T_{chirp} is the period of the sequence[[,]] which equals the length of the training block without the cyclic prefix, and k is an integer index.

11. (Original) The method of claim 1, wherein said training sequence signals comprise a plurality of subsequence signals.

12. (Original) The method of claim 11, wherein said subsequence signals comprise an optimal or near-optimal training sequence due to their preserved orthogonality at the receiver.

13. (Currently Amended) The method of claim 11, wherein said method further comprises:

estimating said channel characteristic for each subsequence;

estimating phase differences between each received subsequence; and

combining estimates to estimate the channel response.

14. (Currently Amended) The method of claim 13, wherein said estimating said channel characteristic for each subsequence comprises estimating said channel characteristic[[s]] for each subsequence using a transform-based channel characteristic estimation procedure.

15. (Currently Amended) ~~The method of claim 13, wherein~~ A method for multi-input multi-output (MIMO) channel estimation, the method comprising:

transmitting training sequence signals from a plurality of transmitting antennas, through said MIMO channel, such that training sequence signal transmissions from at least two of said plurality of transmitting antennas overlap in time, said training sequence signals comprise a plurality of subsequence signals;

receiving said training sequence signals at a plurality of receiving antennas, through said MIMO channel;

comparing said transmitted training sequence signals with said received training sequence signals to generate an estimate of a characteristic of said MIMO channel;

estimating said channel characteristic for each subsequence;

estimating phase differences between each received subsequence; and

combining estimates to estimate the channel response; and

said estimating phase differences between each received subsequence comprises estimating phase differences between each received subsequence using a partial, subsequence-based phase difference estimation procedure.

16. (Original) The method of claim 15, wherein said combining estimates to estimate the channel response comprises combining estimates to estimate the channel response using a phase-correcting estimation combining procedure.

17. (Currently Amended) The method of claim 15, wherein ~~when~~ subsequences sent by an m-th antenna during a time block t are composed of N_{TX} [[Ntx]] blocks each and given by the expression for $x_m[t,k]$ ~~Eq. (22)~~ as follows:

$$x_m[t,k] = \exp(2\pi jmt / N_{block})x_{chirp}[k];$$

where N_{TX} is a number of transmitting antennas, m is an integer index for transmitter antenna number, k is an integer index, N_{block} is a number of training blocks, and $x_{chirp}[k]$ is chirp sequence.

18. (Original) The method of claim 15, wherein each subsequence is one block long, and a block comprises a cyclically-prefixed chirp sequence.

19. (Currently Amended) The method of claim 15, wherein said subsequences are shorter than Tblock and given by the expression for $x_{p,q}[k]$ ~~Eq. (20)~~ as follows:

$$x_{p,q}[k] \propto \exp\left[\pi j \frac{pk^2 + 2qk}{L_{block}}\right] ;$$

where Tblock is a block time, p is an integer that is greater than the number of transmitting antennas N_{TX}, q is a transmitter integer, k is a subsequence index integer, j is an integer, and Lblock is a length of data block without a prefix length.

20. (Currently Amended)) The method of claim 15, wherein the method further comprises denoising the channel estimate by:

calculating a time-domain channel response having a first set of coefficients based, at least in part, on a transform-based procedure performed on the channel estimate;

truncating the time-domain channel response by selecting some of the first set of coefficients and not selecting others of the first set of coefficients; and

calculating a denoised channel response by performing a transform-based procedure on the truncated channel response.

21. (Currently Amended) An apparatus for generating an estimate of a multiple-input multiple-output (MIMO) channel comprising

a plurality of transmit antennas configured to transmit a plurality of training sequences through said MIMO channel, said training sequence signals comprising a plurality of subsequence signals;

a plurality of receive antennas configured to receive said plurality of training sequences through said MIMO channel; and

a receiver coupled to said second plurality of receive antennas and configured to generate an estimate of a response of said MIMO channel comprising a coefficient for each transmit antenna-receive antenna pair;

the MIMO channel response estimate generated by combining an estimate of a channel characteristic for each subsequence, and an estimate of a phase differences between each received subsequence; and

said estimate of the phase difference between each received subsequence being performed using a partial subsequence-based phase difference estimation procedure.

22. (Original) The apparatus of claim 21, wherein said receiver is further configured to denoise said estimate.

Cancel Claims 23-33 without prejudice.

23. (Cancelled)

24. (Cancelled)

25. (Cancelled)

26. (Cancelled)
27. (Cancelled)
28. (Cancelled)
29. (Cancelled)
30. (Cancelled)
31. (Cancelled)
32. (Cancelled)
33. (Cancelled)

34. (Currently Amended) A communication system comprising:

a plurality of transmitters transmitting a plurality of training sequences from a plurality of transmit antennas through a multiple-input multiple-output (MIMO) communications channel, said training sequence signals being sent in blocks and said blocks number as many or more than a number of said plurality of transmitting antennas;

a plurality of receivers receiving said plurality of training sequences by a plurality of receive antennas through said MIMO channel; and

~~a plurality of transmit and receive antennas; and~~

a digital signal processing hardware ~~and/or~~ or a digital signal processing software for channel estimat[e]ion, which disentangles the received signals arriving from different transmitters by transform-based techniques in both frequency and spatial domains, and compensates for frequency offset and phase noise in the local oscillators at the transmitters and receivers by using the redundancy in the received training signals;,

said transmitted training sequence signals in each block have a different phase.

Add claims 35-37 as follows:

35. (New) An apparatus for generating an estimate of a multiple-input multiple-output (MIMO) channel comprising

a plurality of transmit antennas configured to transmit a plurality of training sequences through said MIMO channel, said training sequence signals being sent in blocks and said blocks number as many or more than a number of said transmit antennas, and (i) during one block all transmitted training sequence signals share a same phase and (ii) during another block all transmitted training sequence signals have a different phase;

a plurality of receive antennas configured to receive said plurality of training sequences through said MIMO channel; and

a receiver coupled to said second plurality of receive antennas and configured to generate an estimate of a response of said MIMO channel comprising a coefficient for each transmit antenna-receive antenna pair.

36. (New) An apparatus as in claim 35, wherein:

said training sequence signals comprise a plurality of subsequence signals and the received signals comprise a plurality of received subsequence signals;

said MIMO channel response estimate is generated by combining an estimate of a channel characteristic for each subsequence, and an estimate of a phase differences between each received subsequence; and

said estimate of the phase difference between each received subsequence being performed using a partial subsequence-based phase difference estimation procedure.

37. (New) The method of claim 15, wherein said subsequence signals comprise an optimal or near-optimal training sequence due to their preserved orthogonality at the receiver.